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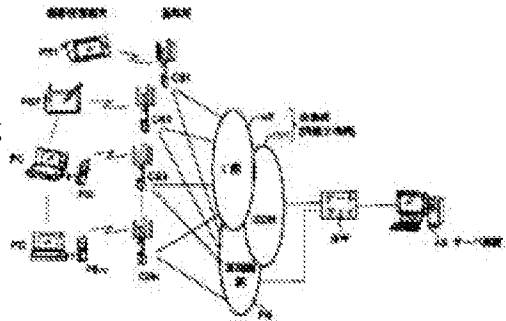
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## (54) **MOBILE DATA COMMUNICATION SYSTEM, ITS BASE STATION DEVICE AND MOBILE TERMINAL**

(57)Abstract:

**PROBLEM TO BE SOLVED:** To execute efficiently a selection request of a radio data communication protocol by selecting an available radio data communication protocol among plural radio data communication protocols based on an idle capacity of each radio channel and informs a mobile terminal being a request source of it.

**SOLUTION:** When a mobile terminal PS1 makes dialing to designate a radio communication data communication protocol, the mobile radio terminal PS1 sends a call connection request used to request a radio data communication protocol to a base station CS1. Upon the receipt of the call connection request from the mobile terminal PS1, the base station CS1 discriminates a connection type and selects a protocol in the case of data communication, detects number of idle radio communication channels and discriminates whether or not a request channel is available. A gateway GW receives a call connection request to open an SVC via a leased line network PN.



## **DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the mobile data communications system which enabled mobile data communication between the data communication units connected to that moving terminal device and wire net, its base station device, and a moving terminal device, for example using PHS (Personal Handy-phone System).

[0002]

[Description of the Prior Art]In recent years, the digital mobile communication system represented by a cellular phone system and PHS has spread quickly. And in addition to voice call service, in this kind of system, offer of the data transmission services which use the Personal Digital Assistant which has a personal computer linked to a portable telephone and a wireless communication function is started.

[0003]For example, when a user is going to acquire desired information etc. from the server apparatus on computer networks, such as the Internet, call origination is carried out from a Personal Digital Assistant to a desired server apparatus. So, then first, it is connected via a radio link and between a Personal Digital Assistant and nearby base stations is continuously accessed by data communication units, such as Gateway, via wire nets, such as a public network, from this base station. And if the connection for data communications is established between a base station and a data communication unit, The information transmitted to the data communication unit via the Internet from the server apparatus is transmitted to a base station via the above-mentioned connection from a data communication unit, and is further transmitted to the Personal Digital Assistant of call origination origin via a radio link from this base station.

[0004]Thus, since the data transmission services using a mobile communication system can perform transmission and reception of an E-mail, the inspection of the Web information on the Internet, etc. even from where at any time, they are very convenient.

[0005]By the way, in this kind of mobile data communications system, several wireless-data-transmission protocols with which the usage numbers of a radio channel differ are given to a moving terminal device these days, A moving terminal device choosing a desired protocol out of these wireless-data-transmission protocols, and performing wireless data transmission is advocated by this invention person etc. For example, the protocol which performs one 32k bps wireless data transmission in the system which uses PHS using a radio channel, The protocol which performs 64k bps wireless data transmission using a radio channel two channels is prepared, and the user of a moving terminal device chooses a desired protocol out of these protocols, requires of a base station, and performs wireless data transmission.

[0006]However, a base station does not always receive the protocol which the user of the moving terminal device demanded. For example, even if a moving terminal device requires the protocol which uses two radio channels, as for a base station, this demand will be refused if there is only one empty radio channel. In this case, the user of a moving terminal device changes a demand protocol into the protocol which uses for example, one radio channel, and performs call origination again. And if this protocol that carried out reclaim is also refused, call origination will be given up, or the protocol in which another communication is possible will be chosen, and call origination of a third-time degree will be performed. That is, the demand of the protocol from a moving terminal device to a base station is performed by trial and error.

[0007]For this reason, in situation [ where especially between non-railroad sections is crowded ] Shimo etc., by the time a radio link is formed between a moving terminal device and a base station, it may take much time. Since the user of a moving terminal device specified a protocol by own judgment, the user in which a user's operational burden is large especially unfamiliar might give up communication.

[0008]

[Problem(s) to be Solved by the Invention]As mentioned above, since the selection request of the wireless-data-transmission protocol was performed by trial and error when trying to communicate in a mobile data communications system, using selectively two or more wireless-

data-transmission protocols, efficient call connection could not be performed and the user's operational burden was heavy.

[0009]The place which this invention was made paying attention to the above-mentioned situation, and is made into that purpose, While enabling it to perform the selection request of a wireless-data-transmission protocol efficiently, it is in providing the mobile data communications system which eased moving terminal apparatus users' operational burden substantially, its base station device, and a moving terminal device.

[0010]

[Means for Solving the Problem]To achieve the above objects, the 1st invention is provided with the following.

It is in a mobile data communications system which gave several wireless-data-transmission protocols with which radio-channel capacity needed for a base station device and a moving terminal device differs, and is a protocol selecting means to a base station device.

Protocol reporting means.

And when a moving terminal device requires mobile data communication, by the above-mentioned protocol selecting means. An usable wireless-data-transmission protocol is chosen from two or more above-mentioned wireless-data-transmission protocols based on an availability of a radio channel, and the above-mentioned protocol reporting means notifies this selected wireless-data-transmission protocol to a moving terminal device of the above-mentioned demand origin. Equip a moving terminal device with a re connection control means, and by this re connection control means. When a wireless-data-transmission protocol which is different from a demand from the above-mentioned base station device to a demand of mobile data communication is notified, it is made to perform a re connection procedure of rerequiring mobile data communication by this notified wireless-data-transmission protocol.

[0011]Therefore, in [ when reception \*\*\*\*\* cannot do a wireless-data-transmission protocol which a moving terminal device required, for example for Reasons of shortage of an empty radio channel, a protocol of outside for use, etc. according to this invention ] a base station, An usable wireless-data-transmission protocol is chosen in the actual condition from two or more radio data protocols, it is notified to a moving terminal device of a requiring agency, and a recurrence call for requiring a wireless-data-transmission protocol notified from this base station is automatically performed with a moving terminal device.

[0012]For this reason, when establishing a radio link between a moving terminal device and a base station, it is lost that a trial-and-error negotiation is repeated, and time which connection of a radio link takes to this is shortened, and useless use of a control channel is controlled. A user of a moving terminal device distinguishes a wireless-data-transmission protocol usable [ self ], it becomes unnecessary to perform the designating operation, and an operational burden is eased.

[0013]When other inventions need to communicate among other moving terminal devices during mobile data communication with a moving terminal device to a base station device, It has a judging means which judges whether a wireless-data-transmission protocol in use to the above-mentioned mobile data communication is maintainable, When judged with maintenance being impossible by this judging means, choose a substitute wireless-data-transmission protocol out of two or more wireless-data-transmission protocols, and this is notified to a moving terminal device under above-mentioned communication, And when a re connection control means is provided in a moving terminal device and a substitute wireless-data-transmission protocol is notified from a base station device during mobile data communication, It is made to perform a re connection procedure for changing to mobile data communication by a wireless-data-

transmission protocol of this notified substitution.

[0014]Therefore, if according to this invention a wireless-data-transmission protocol under above-mentioned communication cannot be maintained when call origination occurs from other moving terminal devices, for example during mobile data communication, A substitute wireless-data-transmission protocol is notified from a base station device to a moving terminal device under mobile data communication, and with a moving terminal device, once ending communication, a recurrence call for requiring communication by a wireless-data-transmission protocol of the above-mentioned substitution is performed. That is, according to empty situations of a radio channel, and a generation state of a call request, a wireless-data-transmission protocol of a moving terminal device under communication is changed automatically.

[0015]for this reason, when a new call connection demand occurs, for example in the state with few openings of a radio channel, it comes to be alike as it is possible to assign a radio channel to a moving terminal device of this demand origin, and enables this to use limited radio resources effectively.

[0016]Another invention supervises an availability of a radio channel during mobile data communication with a moving terminal device to a base station device, It has a judging means which judges whether an increase in radio-channel capacity to mobile data communication under above-mentioned communication is possible based on the monitored result, When judged with an increase being possible by this judging means, a wireless-data-transmission protocol in which transmission capacity is higher than a wireless-data-transmission protocol in use out of two or more above-mentioned wireless-data-transmission protocols is chosen, Notify this to a moving terminal device under above-mentioned communication, and a moving terminal device is equipped with a re connection control means, When a wireless-data-transmission protocol is notified from a base station device during mobile data communication, it is made to perform a re connection procedure for changing to mobile data communication by this notified wireless-data-transmission protocol.

[0017]Therefore, even if a wireless-data-transmission protocol which uses a small number of radio channel performs mobile data communication at the beginning of a communication start, for example according to this invention, If an empty radio channel occurs and it becomes available about this empty channel during communication, a wireless-data-transmission protocol under above-mentioned communication will be changed into a protocol which uses more radio channels. For this reason, an empty radio channel can be used more effectively and transmission efficiency of mobile data communication can be raised.

[0018]In each above invention, it constitutes so that a wireless-data-transmission protocol with a selected protocol selecting means may be notified using a procedure for cutting a radio link between moving terminal devices. If it does in this way, a protocol can be notified using the existing disconnection procedure, without newly establishing a special procedure for notifying a protocol.

[0019]After securing radio-channel capacity of an opening required to perform call connection among at least one moving terminal device, a wireless-data-transmission protocol which should be notified to a moving terminal device is chosen. If it does in this way, the new call connection demand from a moving terminal device is receivable in any times.

[0020]Each above-mentioned invention is added to a wireless-data-transmission protocol which uses a radio channel for a base station device and a moving terminal device, In [ give a wireless packet communication protocol which uses a wireless control channel, and ] a protocol selecting means, When capacity of a radio channel required to perform mobile data communication by a

wireless-data-transmission protocol is insufficient, it is characterized also by choosing the above-mentioned wireless packet communication protocol which uses a wireless control channel. By doing in this way, even when an opening is completely lost to a radio channel, it becomes possible to perform wireless packet communication which uses a control channel.

[0021]

[Embodiment of the Invention] Hereafter, one embodiment of this invention is described with reference to Drawings. Drawing 1 is an outline lineblock diagram of the mobile data communications system concerning one embodiment of this invention, and CS1-CSn show the base station of PHS. Distributed allocation is carried out geographically and these base stations CS1-CSn form wireless area in the service area which a system covers by one or plurality.

[0022] The moving terminal devices PS1-PSm are connected to a nearby base station via a wireless circuit [ in the cell which each above-mentioned base stations CS1-CSn form ]. As a radio access method between this base station and a moving terminal device, a TDMA-TDD (Time Division Multiple Access -Time Division Duplex) method is used, for example. There are a Personal Digital Assistant provided with a data communication facility and radio accessing function other than the portable telephone which has only a talking function, and a thing which connected personal computer PC to the portable telephone in the moving terminal devices PS1-PSm.

[0023] Each above-mentioned base stations CS1-CSn are connected to leased line network PN via a dedicated line while being connected to I' interface network (I' network is called henceforth) IN2 via a subscriber line, respectively. I' network IN2 is for accommodating the base stations CS1-CSn of PHS, and it constitutes the public network which consists of line switching networks with integrated service digital network (ISDN) IN1. Much line terminal equipment (not shown) is connected to ISDN network IN1. Leased line network PN performs packet switching according to the protocol which constitutes a packet network, for example, is specified to X.25.

[0024] Gateway G W as a data communication unit is connected to the above-mentioned ISDN network IN1 and leased line network PN, and server apparatus AS is connected to them via the Internet at this Gateway G W. Server apparatus AS has a function as a mail server at the time of transmitting an E-mail the moving terminal devices PS1-PSm and between line terminal equipment, and. It has a function as a contents server which notifies Web information, including news, an advertisement, etc., to the moving terminal devices PS1-PSm and line terminal equipment. A TCP/IP protocol is used for the information transmission between Gateway G W and server apparatus AS.

[0025] It is also possible to connect between Gateway G W and server apparatus AS via a network, and it is also possible to mount the function as a server apparatus in Gateway G W further.

[0026] By the way, in the above mobile data communications systems the base stations CS1-CSn and the moving terminal devices PS1-PSm, For example, the protocol A which performs 32k bps wireless data transmission using a radio channel one channel. The protocol B which performs 64k bps wireless data transmission using a radio channel two channels. It has the protocol C which performs wireless packet communication using a control channel, a desired protocol is chosen out of these protocols A, B, and C, and wireless data transmission can be performed now.

[0027] As a gestalt of a data communication system, there are a data communication system held between line terminal equipment (not shown) and a data communication system held via leased line network PN between the terminal units in which packet switching is possible via ISDN network IN1.

[0028]Hereafter, the composition of each device which constitutes the system of this embodiment is explained in detail. The moving terminal devices PS1-PSm are constituted as follows first. Drawing 2 is a functional block diagram showing the composition.

[0029]The moving terminal devices PS1-PSm are provided with the following.

The wireless section 1 provided with the antenna 11.

Modem section 2.

TDMA section 3.

The call part 4, the control section 5, the information storage part 6, the data communication part 7, the indicator 8, and the key input section 9.

[0030]That is, the radio transmission wave signal which came from the base stations CS1-CSn is inputted into the receive section 13 via the high frequency switch (SW) 12 of the wireless section 1, after being received by the antenna 11. In this receive section 13, the radio transmission wave signal received [ above-mentioned ] is mixed with the local oscillation signal generated from the frequency synthesizer 14, and a down convert is carried out to a received intermediate frequency signal. The local oscillation signal frequency generated from the above-mentioned frequency synthesizer 14 is set as the value corresponding to radio-channel frequency by directions of the control section 5. The receiving-field-intensity primary detecting element (RSSI) 16 is established in the wireless section 1. In this receiving-field-intensity primary detecting element 16, the receiving field intensity of the radio transmission wave signal which came from the base stations CS1-CSn is detected, and that detection value is notified to the control section 5, in order to perform a judgment and display of receiving quality.

[0031]The received intermediate frequency signal outputted from the above-mentioned receive section 13 is inputted into the demodulation section 21 of the modem section 2. In the demodulation section 21, digital demodulation of the above-mentioned received intermediate frequency signal is performed, and, thereby, a digital demodulation signal is reproduced.

[0032]The TDMA decode part 31 of TDMA section 3 separates the above-mentioned digital demodulation signal for every reception time slot. And if the data of the separated slot is voice data, this voice data will be inputted into the interface part 4. On the other hand, these data will be inputted into the data communication part 7 if the data of the separated slot is packet data and control data.

[0033]The call part 4 is provided with the following.

ADPCM (Adaptive Differential Pulse Code Modulation) transformer coder 41.

PCM codec 42.

Loudspeaker 43.

Microphone 44.

ADPCM transcoder 41 decodes the voice data outputted from the above-mentioned TDMA decode part 31. PCM codec 42 changes into an analog signal the digital sound signal outputted from above-mentioned ADPCM transcoder 41, and carries out the sound-reinforcement output of this audio signal from the loudspeaker 43.

[0034]The data communication part 7 receives the data outputted from the above-mentioned TDMA decode part 31, and supplies this data to the control section 5. If received data are control data, the control section 5 will analyze this control data, and will perform required control. On the other hand, if received data are the packet data which came from the server apparatus etc., after depacketizing these packet data, it will memorize to the information storage part 6, and it is made to supply and display on the indicator 8 which consists of liquid crystal displays (LCD),

for example.

[0035]On the other hand, after PCM coding is carried out by PCM codec 42, compression encoding of a user's audio signal inputted into the microphone 44 is further carried out by ADPCM transcoder 41. And this coded voice data is inputted into the TDMA encode part 32. Control data and packet data which were outputted from the control section 5 are inputted into the above-mentioned TDMA encode part 32 through the data communication part 7.

[0036]The digital sound data of each channel outputted from above-mentioned ADPCM transcoder 41 and the control data outputted from the data communication part 7, and packet data are inserted in the transmission time slot to which it was directed from the control section 5, and the TDMA encode part 32 multiplexes them. The modulation part 22 carries out digital modulation of the transmitted intermediate frequency signal with the multiplexing digital communication signal outputted from the above-mentioned TDMA encode part 32, and inputs this modulated transmitted intermediate frequency signal into the transmission section 15.

[0037]The transmission section 15 mixes the transmitted intermediate frequency signal modulated [ above-mentioned ] with the local oscillation signal generated from the synthesizer 14, does upconverting to radio transmission wave frequency, and amplifies to a further predetermined transmission power level. The outputted radio transmission wave signal is transmitted towards the base stations CS1-CSn via the high frequency switch 12 from the antenna 11 from this transmission section 15.

[0038]By the way, the control section 5 is what made the microcomputer the main control part, and is provided with the notice reception means 51 of a protocol, and the re connection control means 52 as a control facility concerning this invention.

[0039]The notice reception means 51 of a protocol receives this protocol information, when protocol information is sent from the base stations CS1-CSn mentioned later during execution of call connection processing, or mobile data communication using the notice of cutting.

[0040]When protocol information is received with the notice of cutting by the above-mentioned notice reception means 51 of a protocol, the re connection control means 52 turns the call connection demand for requiring the data communications by this newly notified protocol information to the base stations CS1-CSn, and transmits.

[0041]On the other hand, the base stations CS1-CSn are constituted as follows. Drawing 3 is a circuit block figure showing the composition. The base stations CS1-CSn are provided with the following.

The wireless section 10 provided with the antenna 111.

Modem section 20.

TDMA section 30.

The interface part 40, the control section 50, the information storage part 60, and the data communication part 70.

[0042]That is, the radio transmission wave signal which came from the moving terminal devices PS1-PSm is inputted into the receive section 113 via the high frequency switch (SW) 112 of the wireless section 10, after being received by the antenna 111. In this receive section 113, the radio transmission wave signal received [ above-mentioned ] is mixed with the local oscillation signal generated from the frequency synthesizer 114, and a down convert is carried out to a received intermediate frequency signal. The frequency of the local oscillation signal generated from the above-mentioned frequency synthesizer 114 is directed from the control section 50 according to radio-channel frequency. The receiving-field-intensity primary detecting element (RSSI) 116 is

established in the wireless section 10. In this receiving-field-intensity primary detecting element 116, the receiving field intensity of the radio transmission wave signal which came from the moving terminal devices PS1-PSm is detected, and that detection value is notified to the control section 50 for an empty channel search, the handover control of a moving terminal device, etc.

[0043]The received intermediate frequency signal outputted from the above-mentioned receive section 113 is inputted into the demodulation section 221 of the modem section 20. In the demodulation section 221, digital demodulation of the above-mentioned received intermediate frequency signal is performed, and, thereby, a digital demodulation signal is reproduced.

[0044]The TDMA decode part 331 of TDMA section 30 separates the above-mentioned digital demodulation signal for every reception time slot. And if the data of the separated slot is voice data, this voice data will be inputted into the interface part 40. On the other hand, these data will be inputted into the data communication part 70 if the data of the separated slot is packet data and control data.

[0045]The interface part 40 comprises the ADPCM (Adaptive Differential Pulse Code Modulation) transformer coder 441, the public line interface 442, and the dedicated line interface 443.

[0046]ADPCM transcoder 441 decodes the voice data outputted from the above-mentioned TDMA decode part 331. This decoded digital sound signal is sent out from the public line interface 442 to I' network IN2. The public line interface 442 performs call connection processing to I' network IN2 according to directions of the control section 50. The dedicated line interface 443 performs establishment processing of the connection for packet communication to leased line network PN, etc. according to directions of the control section 50.

[0047]The data communication part 70 will input this control data into the control section 50, if the data which came from the moving terminal devices PS1-PSm is control data addressed to a local station. The control section 50 performs establishment processing etc. of the connection for packet communication which uses leased line network PN between Gateway G W based on this control data. On the other hand, if the data which came from the moving terminal devices PS1-PSm is the packet data addressed to the exterior, the data communication part 70 sends out these packet data to leased line network PN via the dedicated line interface 443.

[0048]On the other hand, the digital communication signal which came from I' network IN2 is received by the public line interface 442. And if the above-mentioned digital communication signal is voice data, compression coding processing will be performed by ADPCM transcoder 441, and it will be inputted into the TDMA encode part 332. On the other hand, it will be inputted into the data communication part 70 if the above-mentioned digital communication signal is control data. The packet data which came from leased line network PN are inputted into the data communication part 70 via the dedicated line interface 443.

[0049]The data communication part 70 will input the data concerned into the TDMA encode part 332, if the addresses of the inputted data are the moving terminal devices PS1-PSm. On the other hand, if the inputted data is control data addressed to a local station, the control data concerned will be inputted into the control section 50. The control section 50 analyzes this inputted control data, and controls many things. The control section 50 outputs the control data addressed to moving terminal device PS1 - PSm to the above-mentioned TDMA encode part 332 via the data communication part 70.

[0050]The digital sound data of each channel outputted from above-mentioned ADPCM transcoder 441, the control data outputted from the data communication part 70, and packet data are inserted in the transmission time slot to which it was directed from the control section 50, and



the TDMA encode part 332 multiplexes them. The modulation part 222 carries out digital modulation of the transmitted intermediate frequency signal with the multiplexing digital communication signal outputted from the above-mentioned TDMA encode part 332, and inputs this modulated transmitted intermediate frequency signal into the transmission section 115.

[0051]The transmission section 115 mixes the transmitted intermediate frequency signal modulated [ above-mentioned ] with the local oscillation signal generated from the synthesizer 114, does upconverting to radio transmission wave frequency, and amplifies to a further predetermined transmission power level. The outputted radio transmission wave signal is transmitted towards the moving terminal devices PS1-PSm via the high frequency switch 112 from the antenna 111 from this transmission section 115.

[0052]By the way, the control section 50 is provided with the following.

It is the call connection control means 551 as a control facility concerning [ have a microcomputer as a main control part and ] this invention.

Protocol alteration decision means 552.

Protocol selecting means 553.

Protocol notification control means 554.

[0053]When a call connection demand comes from the moving terminal devices PS1-PSm and public network IN1, IN2, or leased line network PN, the call connection control means 551, An empty radio channel is chosen, this is assigned to the moving terminal devices PS1-PSm, and a radio link is established among the moving terminal devices PS1-PSm by performing predetermined procedures, such as a synchronization and attestation, further.

[0054]The protocol alteration decision means 552 is in the state where mobile data communication is performed among arbitrary moving terminal devices, When a call request comes from other moving terminal devices, it is judged whether a wireless-data-transmission protocol in use [ based on the number of empty channels in this time ] to the above-mentioned mobile data communication is maintainable. In the state where under mobile data communication is performed among arbitrary moving terminal devices with it. When the change in the number of empty channels of a radio channel is supervised and the number of empty channels increases by release of a radio channel, etc., it is judged whether the increase in the radio channel number to the mobile data communication under above-mentioned communication is possible.

[0055]The protocol selecting means 553 judges whether it is usable in the wireless-data-transmission protocol sent with this call connection demand based on the number of empty channels of the radio channel in this time, when a call connection demand comes from the moving terminal devices PS1-PSm. And when unusable, an usable protocol is chosen out of other wireless-data-transmission protocols. When judged with a wireless-data-transmission protocol in use being unmaintainable by the above-mentioned protocol alteration decision means 552, And also when judged with the increase in the radio channel number to the mobile data communication under communication being possible, an usable protocol is chosen out of other wireless-data-transmission protocols.

[0056]When the wireless-data-transmission protocol which should be changed in the above-mentioned protocol selecting means 553 is chosen, the protocol notification control means 554 includes the information for notifying this wireless-data-transmission protocol in the notice of cutting, and sends it out to the moving terminal devices PS1-PSm.

[0057]Next, operation of the system constituted as mentioned above is explained. It explains

using the flow chart shown in drawing 4 and drawing 6 about operation when the moving terminal devices PS1-PSm require call connection first, and the sequence diagram shown in drawing 8 and drawing 9.

[0058]In now, for example, moving terminal, device PS1, calling operation for a user's mobile data communication is performed, and suppose that the wireless-data-transmission protocol A which uses two radio channels at Step 4a as shown in drawing 4 in that case was specified. If it does so, the call connection demand which requires the wireless-data-transmission protocol A will be transmitted towards base station CS1 from moving terminal device PS1.

[0059]If a call connection demand comes from moving terminal device PS1, base station CS1 will receive this call connection demand at Step 6a, and it will judge a connection type at Step 6b. And if the demanded connection types are data communications, a protocol will be selected at Step 6c. That is, the number of empty channels of the radio channel in this time is detected, and it is judged this autumn whether it is usable in the wireless-data-transmission protocol A which the above-mentioned moving terminal device PS1 required based on a channel number.

[0060]There are the numbers of empty channels of enough temporarily now, and if usable, the above-mentioned protocol A, It shifts to Step 6d and the connection for data communications is established for a radio channel required for the above-mentioned protocol A between 2 channel assignment and moving terminal device PS1 to moving terminal device PS1 of a requiring agency. Base station CS1 sends out a call connection demand to Gateway G W via leased line network PN with it. Gateway G W establishes SVC (Switching Virtual Circuit) which passes leased line network PN between base station CS1 of a requiring agency in response to the call connection demand of a call.

[0061]And if the connection for data communications is established between Gateway G W, base station CS1 will send out a connection response to moving terminal device PS1 in Step 6e, and it will perform data relay operation by Step 6f henceforth. In 4 g of steps, moving terminal device PS1 will start data-communications operation henceforth, if the connection response from base station CS1 is received at Step 4b. Drawing 8 is a sequence diagram showing operation when use of the wireless-data-transmission protocol A which moving terminal device PS1 required as mentioned above is permitted.

[0062]On the other hand, there is only the one number of empty channels of a radio channel temporarily now, and suppose that the protocol A which moving terminal device PS1 required was not able to be used. In this case, base station CS1 selects other usable wireless-data-transmission protocols in Step 6c. For example, the wireless-data-transmission protocol B which uses one radio channel here is selected. And it shifts to 6 g of steps, and the information which specifies the above-mentioned wireless-data-transmission protocol B as the notice of cutting is inserted as a notice of cutting, and it transmits.

[0063]If the notice of cutting comes from base station CS1 after sending out of a call connection demand, moving terminal device PS1 will shift to Step 4c from Step 4b, and it will judge the disconnect reason of the notice of cutting here. Since the specification information on the wireless-data-transmission protocol B is inserted as a disconnect reason here, Moving terminal device PS1 shifts to Step 4e, it extracts the above-mentioned wireless-data-transmission protocol B, and transmits the call connection demand for requiring the data communications by this newly specified wireless-data-transmission protocol B at Step 4f to base station CS1.

[0064]As it said previously that a call connection demand comes from moving terminal device PS1, base station CS1 by Step 6e from Step 6a. If processing which establishes the connection for data communications, respectively is performed and a connection is established between

moving terminal device PS1 and between Gateway G W, data relay processing will be performed at Step 6f.

[0065] Drawing 9 is a sequence diagram showing operation when the use of the wireless-data-transmission protocol A which moving terminal device PS1 required described above is refused and base station CS1 specifies another usable wireless-data-transmission protocol B.

[0066] In the judgment by the above-mentioned step 6c, when there is no opening in a radio channel and there is no usable wireless-data-transmission protocol, base station CS1 transmits the notice of cutting which includes a connection refusal as a disconnect reason in 6 g of steps. Moving terminal device PS1 will shift to Step 4d from Step 4c, if this notice of cutting is received, it abandons and awaits a call connection demand here, and returns to a state.

[0067] Next, it explains using the flow chart shown in drawing 5, drawing 6, and drawing 7 about the operation in the case of making a protocol change during data communications, and the sequence diagram shown in drawing 10 and drawing 11.

[0068] In the state where moving terminal device PS1 is performing data communications between base station CS1 using the wireless-data-transmission protocol B, other moving terminal device PS2 presuppose that the call connection demand which requires a telephone call was transmitted so that it may be shown in now, for example, drawing 10.

[0069] A connection type is judged as base station CS1 receiving the above-mentioned call connection demand at Step 6a at Step 6b, and since it is a call request here, it is judged whether it shifts to Step 6h and an empty channel is in a radio channel here. And if there is an empty channel, processing for connecting a speech path between moving terminal device PS2 of call-request origin at Step 6i will be performed. The call connection demand to a call partner's terminal unit is sent out to public network IN1 and IN2 with it. And if a speech path is established between mating terminal devices, a connection response will be transmitted to moving terminal device PS2 at Step 6j. If moving terminal device PS2 receives the above-mentioned connection response, the telephone call of it will be henceforth attained between a call partner's terminal units.

[0070] On the other hand, suppose that there was no opening in a radio channel in the judgment of the above-mentioned step 6h. If it does so, it will be judged whether base station CS1 shifts to Step 6k, and it has the moving terminal device which is communicating here using the radio channel. And if there is no moving terminal device under mobile data communication, it will judge that there is no radio channel which should be assigned to the above-mentioned moving terminal device PS2, and a connection refusal will be transmitted to moving terminal device PS2 of call origination origin at Step 6p.

[0071] However, since moving terminal device PS1 is communicating [ be / it ] here using a radio channel, base station CS1 judges that the radio channel currently assigned to this moving terminal device PS1 may be able to accommodate moving terminal device PS2, shifts to Step 6q, and selects an alternative protocol. And if moving terminal device PS1 under data communications is provided with the wireless packet communication protocol, for example, a wireless packet communication protocol will be selected. And the notice of cutting which includes the specification information on this wireless packet communication protocol as a disconnect reason is transmitted to moving terminal device PS1 under data communications, and the radio channel currently assigned to moving terminal device PS1 after this transmission is released. The data-communications connection established between base station CS1 and Gateway G W at this time is held as it is.

[0072] And base station CS1 assigns the radio channel which released [ above-mentioned ] to

moving terminal device PS2 of call origination origin, If the call connection to a call partner's terminal unit is furthermore required from public network IN1 and IN2 and a speech path is formed between this call partner's terminal units, a call connection response will be returned to moving terminal device PS2 of call origination origin. Moving terminal device PS2 of call origination origin will be in a call possible state henceforth, if a call connection response is received.

[0073]On the other hand, moving terminal device PS1 under data communications will judge a disconnect reason at Step 5b, if the notice of cutting is received at Step 5a as shown in drawing 5 during data communications. And since the specification information on a wireless packet communication protocol is inserted in the disconnect reason here, It shifts to Step 5d and a specification protocol is detected, and at Step 5e, the call connection demand for requiring the data communications by this specified wireless packet communication protocol is turned to base station CS1, and it transmits.

[0074]When a call connection demand comes from moving terminal device PS1, base station CS1 by Step 6e from Step 6a. The radio link for wireless packet communications which uses a control channel between moving terminal device PS1 is established, and this radio link is connected to the connection for data communications established between Gateway G W.

[0075]Therefore, moving terminal device PS1 continues the data communications between Gateway G w henceforth using a wireless packet communication protocol. The sequence of the variation operation from the wireless-data-transmission protocol A to the wireless packet communication protocol described above is shown in drawing 10.

[0076]Now, suppose that other moving terminal devices PSi under moving terminal device PS2 or telephone call closed the telephone call, and the radio channel was released by this in the state where data communications are performed using the wireless packet communication protocol as described above. At this time, base station CS1 will return a call clear-down response to this moving terminal device PS2 or PSi at Step 7b, if moving terminal device PS2 or the call clear-down demand from PSi is received at Step 7a as shown in drawing 7. And the existence of the moving terminal device under data communications is judged at Step 7c next.

[0077]As a result of this judgment, if there is no moving terminal device under data communications, processing will be ended as it is, but since moving terminal device PS1 is during data communications here, base station CS1 shifts to Step 7d, and it chooses the wireless-data-transmission protocol B which uses the radio channel released [ above-mentioned ] here. And it shifts to Step 7f from Step 7e, and the notice of cutting which makes a disconnect reason the above-mentioned wireless-data-transmission protocol B here is turned to moving terminal device PS1 under data communications, and it transmits. And the control channel which moving terminal device PS1 is using is released. The data-communications connection established between base station CS1 and Gateway G W at this time is held as it is.

[0078]If the notice of cutting comes from base station CS1 during data communications, moving terminal device PS1 will perform again the call connection request process for changing the wireless-data-transmission protocol under communication into the wireless-data-transmission protocol specified from base station CS1, as shown in Steps 5a-5f of drawing 5.

[0079]In this way, the protocol of moving terminal device PS1 is changed into the wireless-data-transmission protocol B which uses one radio channel from the wireless packet communication protocol which uses a control channel, and data communications are henceforth continued using this wireless-data-transmission protocol B. Drawing 11 is a sequence diagram showing the change control to the wireless-data-transmission protocol B from the wireless packet

communication protocol described above.

[0080]As stated above, when a call connection demand occurs from the moving terminal devices PS1-PSm, in this embodiment, it is judged whether it is usable in the wireless-data-transmission protocol demanded based on the empty situations of the radio channel in that time in the base stations CS1-CSn. And if impossible, an usable wireless-data-transmission protocol will be chosen out of two or more wireless-data-transmission protocols currently prepared beforehand, this is included in the notice of cutting, and it notifies to the moving terminal devices PS1-PSn. The notice of cutting comes, and the moving terminal devices PS1-PSm will transmit the call connection demand for requiring the data communications by this specified protocol, if that disconnect reason is specification of a protocol.

[0081]Therefore, according to this embodiment, with the moving terminal devices PS1-PSm, a recurrence call is automatically performed according to the protocol specified from the base stations CS1-CSn. For this reason, when establishing a radio link between the moving terminal devices PS1-PSm and the base stations CS1-CSn, it is lost that a trial-and-error negotiation is repeated, and the time which connection of a radio link takes to this is shortened, and useless use of a control channel is also controlled. The user of the moving terminal devices PS1-PSm distinguishes a wireless-data-transmission protocol usable [ self ], it becomes unnecessary to perform the designating operation, and an operational burden is eased substantially.

[0082]A call connection demand occurs from other moving terminal devices in the state where arbitrary moving terminal devices are performing data communications in this embodiment, When there is no radio channel which should be assigned to this moving terminal device, he is trying to make the protocol of the moving terminal device under above-mentioned data communications change into the wireless packet communication protocol which uses a control channel.

[0083]Corresponding [ therefore, ] to the empty situations of a radio channel, and the generation state of a call request, The wireless-data-transmission protocol of the moving terminal device under communication will be changed automatically, thereby -- for example, when a new call connection demand occurs in the state with few openings of a radio channel, it becomes impossible that it is alike in it being possible to assign a radio channel to the moving terminal device of this demand origin, and, as a result, limited radio resources can be used effectively.

[0084]When an opening is made to a radio channel in the state where the still more arbitrary moving terminal devices in this embodiment are performing data communications, He is trying to change the wireless packet communication protocol which the moving terminal device under above-mentioned data communications is using into the wireless-data-transmission protocol B which uses the radio channel of the above-mentioned opening.

[0085]Therefore, it becomes possible to use an empty radio channel more effectively, and, thereby, data transmission efficiency can be held more highly. A fear of the moving terminal devices PS1-PSm monopolizing a control channel over a long period of time rather than anything disappears, and the fault which interferes with the call origination from other moving terminal devices, etc. by this is reduced.

[0086]And since he is trying to use the notice of cutting when specifying a wireless-data-transmission protocol as the moving terminal devices PS1-PSm from the base stations CS1-CSn in this embodiment, A protocol can be notified using the existing disconnection procedure, without newly establishing the special procedure for notifying a protocol.

[0087]This invention is not limited to the above-mentioned embodiment. For example, although the above-mentioned embodiment explained two kinds of wireless-data-transmission protocols A

and B which use a radio channel, and the wireless packet communication protocol which uses a control channel taking the case of the case where it is used selectively, usable [ at the time ] out of three or more kinds of wireless-data-transmission protocols with which the usage numbers of a radio channel differ -- it may be made to choose a large protocol for transmission capacity most [0088]It is good to provide the function which displays the protocol under selection and communication on a moving terminal device using a protocol name, its number, or a mark. Whenever it does in this way, the protocol which a user is using can be known clearly. Especially this is effective when there is change of a protocol from a base station. [0089]In addition, about composition of the kind of mobile communication system, composition, a moving terminal device, and a base station, a Notification-of-Election procedure of a protocol, a modification procedure, a control content, etc. of that control content and a protocol, in the range which does not deviate from the gist of this invention, it changes variously and can carry out.

[0090]

[Effect of the Invention]In [ as explained in full detail above the mobile data communications system which gave several wireless-data-transmission protocols with which the radio-channel capacity needed for a base station device and a moving terminal device differs has this invention, and ] a base station device, When a moving terminal device requires mobile data communication, an usable wireless-data-transmission protocol is chosen from two or more above-mentioned wireless-data-transmission protocols based on the availability of a radio channel, In [ notify this selected wireless-data-transmission protocol to the moving terminal device of the above-mentioned demand origin, and ] a moving terminal device, When a wireless-data-transmission protocol which is different from a demand from the above-mentioned base station device to the demand of mobile data communication is notified, it is made to perform the re connection procedure of rerequiring the mobile data communication by this notified wireless-data-transmission protocol.

[0091]Therefore, according to this invention, the mobile data communications system which can perform the selection request of a wireless-data-transmission protocol efficiently, and can ease moving terminal apparatus users' operational burden substantially, its base station device, and a moving terminal device can be provided.

## CLAIMS

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[Claim(s)]

[Claim 1]At least one base station device characterized by comprising the following which forms wireless area, Two or more moving terminal devices connected via a radio channel to this base station device, A mobile data communications system which is provided with a data communication unit connected via a communications network to said base station device, establishes a connection for data communications between this data communication unit and said moving terminal device, and transmits data to it using this connection.

Have said base station device and a moving terminal device, and several wireless-data-transmission protocols with which radio-channel capacity to need differs said base station device, A protocol selecting means which chooses an usable wireless-data-transmission protocol from said two or more wireless-data-transmission protocols based on an availability of a radio channel when said moving terminal device requires mobile data communication.

Have a protocol reporting means which notifies a wireless-data-transmission protocol with this selected protocol selecting means to a moving terminal device of said demand origin, and said moving terminal device, A re connection control means which performs a re connection procedure of rerequiring mobile data communication by this notified wireless-data-transmission protocol when a wireless-data-transmission protocol which is different from a demand from said base station device to a demand of mobile data communication is notified.

[Claim 2]At least one base station device characterized by comprising the following which forms wireless area, Two or more moving terminal devices connected via a radio channel to this base station device, A mobile data communications system which is provided with a data communication unit connected via a communications network to said base station device, establishes a connection for data communications between this data communication unit and said moving terminal device, and transmits data to it using this connection.

Have said base station device and a moving terminal device, and several wireless-data-transmission protocols with which radio-channel capacity to need differs said base station device, A judging means which judges whether a wireless-data-transmission protocol in use to said mobile data communication can be maintained when it is necessary to communicate among other moving terminal devices during mobile data communication with a moving terminal device.

A protocol selecting means which chooses a substitute wireless-data-transmission protocol out of said two or more wireless-data-transmission protocols when judged with maintenance being impossible by this judging means.

Have a protocol reporting means which notifies a wireless-data-transmission protocol of substitution with this selected protocol selecting means to a moving terminal device under said communication, and said moving terminal device, A re connection control means which performs a re connection procedure for changing to mobile data communication by a wireless-data-transmission protocol of this notified substitution when a substitute wireless-data-transmission protocol is notified from said base station device during mobile data communication.

[Claim 3]At least one base station device characterized by comprising the following which forms wireless area, Two or more moving terminal devices connected via a radio channel to this base station device, A mobile data communications system which is provided with a data communication unit connected via a communications network to said base station device, establishes a connection for data communications between this data communication unit and said moving terminal device, and transmits data to it using this connection.

Have said base station device and a moving terminal device, and several wireless-data-transmission protocols with which transmission capacity of a radio channel differs said base station device, A judging means which supervises an availability of a radio channel during mobile data communication with a moving terminal device, and judges whether an increase in

radio-channel capacity to mobile data communication under said communication is possible based on the monitored result.

A protocol selecting means which chooses a wireless-data-transmission protocol in which transmission capacity is higher than a wireless-data-transmission protocol in use out of said two or more wireless-data-transmission protocols when judged with an increase being possible by this judging means.

Have a protocol reporting means which notifies a wireless-data-transmission protocol with this selected protocol selecting means to a moving terminal device under said communication, and said moving terminal device, A re connection control means which performs a re connection procedure for changing to mobile data communication by this notified wireless-data-transmission protocol when a wireless-data-transmission protocol is notified from said base station device during mobile data communication.

[Claim 4]The mobile data communications system according to any one of claims 1 to 3 characterizing by said protocol reporting means notifying a wireless-data-transmission protocol with a selected protocol selecting means using a procedure for cutting a radio link between moving terminal devices.

[Claim 5]After said protocol selecting means secures radio-channel capacity of an opening required to perform call connection among at least one moving terminal device, The mobile data communications system according to any one of claims 1 to 3 choosing a wireless-data-transmission protocol which should be notified to a moving terminal device.

[Claim 6]Have the following, and when a radio channel is insufficient of availabilities required to perform mobile data communication by a wireless-data-transmission protocol, said protocol selecting means, The mobile data communications system according to any one of claims 1 to 3 choosing said wireless packet communication protocol which uses a wireless control channel. At least one wireless-data-transmission protocol with which a radio channel is used for said base station device and a moving terminal device.

A wireless packet communication protocol which uses a wireless control channel.

[Claim 7]It is connected to a moving terminal device via a wireless circuit, and is connected to a data communication unit via a communications network, In a base station device which relays data communications performed according to a protocol selected from two or more wireless-data-transmission protocols using a connection established between said moving terminal device and said data communication unit, A protocol selecting means which chooses an usable wireless-data-transmission protocol from said two or more wireless-data-transmission protocols based on an availability of a radio channel when said moving terminal device requires mobile data communication, A wireless-data-transmission protocol with this selected protocol selecting means is notified to a moving terminal device of said demand origin, A base station device possessing a protocol reporting means which performs a re connection procedure for making mobile data communication by this notified wireless-data-transmission protocol require of the



base station device concerned.

[Claim 8] It is connected to a moving terminal device via a wireless circuit, and is connected to a data communication unit via a communications network, In a base station device which relays data communications performed according to a protocol selected from two or more wireless-data-transmission protocols using a connection established between said moving terminal device and said data communication unit, A judging means which judges whether a wireless-data-transmission protocol in use to said mobile data communication can be maintained when it is necessary to communicate among other moving terminal devices during mobile data communication with a moving terminal device, A protocol selecting means which chooses a substitute wireless-data-transmission protocol out of said two or more wireless-data-transmission protocols when judged with maintenance being impossible by this judging means, A wireless-data-transmission protocol of substitution with this selected protocol selecting means is notified to a moving terminal device under said communication, A base station device possessing a protocol reporting means which makes the moving terminal device concerned perform a re connection procedure for changing to mobile data communication by a wireless-data-transmission protocol of this notified substitution.

[Claim 9] It is connected to a moving terminal device via a wireless circuit, and is connected to a data communication unit via a communications network, In a base station device which relays data communications performed according to a protocol selected from two or more wireless-data-transmission protocols using a connection established between said moving terminal device and said data communication unit, A judging means which supervises an availability of a radio channel during mobile data communication with a moving terminal device, and judges whether an increase in radio-channel capacity to mobile data communication under said communication is possible based on the monitored result, A protocol selecting means which chooses a wireless-data-transmission protocol in which transmission capacity is higher than a wireless-data-transmission protocol in use out of said two or more wireless-data-transmission protocols when judged with an increase being possible by this judging means, A wireless-data-transmission protocol with this selected protocol selecting means is notified to a moving terminal device under said communication, A base station device possessing a protocol reporting means which makes the moving terminal device concerned perform a re connection procedure for changing to mobile data communication by this notified wireless-data-transmission protocol.

[Claim 10] It is connected via at least one base station device and radio channel which form wireless area, In a moving terminal device which performs data communications using a protocol which established a connection and was chosen from two or more wireless-data-transmission protocols between data communication units connected with said base station device via a communications network, When a wireless-data-transmission protocol which is different from a wireless-data-transmission protocol a demand or in use from said base station device is notified during a demand of mobile data communication, or after a communication start, A moving terminal device provided with a re connection control means which performs a re connection procedure for changing to mobile data communication by this notified wireless-data-transmission

protocol.

## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The outline lineblock diagram showing one embodiment of the mobile data communications system concerning this invention.

[Drawing 2] The circuit block figure showing the composition of the moving terminal device in the system shown in drawing 1.

[Drawing 3] The circuit block figure showing the composition of the base station in the system shown in drawing 1.

[Drawing 4] The flow chart which shows the operation procedures in the call connection demand of the moving terminal device shown in drawing 2, and its contents.

[Drawing 5] The flow chart which shows the operation procedures under mobile data communication of the moving terminal device shown in drawing 2, and its contents.

[Drawing 6] The flow chart which shows the operation procedures of the base station shown in drawing 3, and its contents.

[Drawing 7] The flow chart which shows the operation procedures at the time of cutting of the base station shown in drawing 3, and its contents.

[Drawing 8] The sequence diagram showing the normal operation of the call connection demand in the system shown in drawing 1.

[Drawing 9] The sequence diagram showing the protocol variation operation of the call connection demand in the system shown in drawing 1.

[Drawing 10] The sequence diagram showing an example of the protocol variation operation at the time of the communication in the system shown in drawing 1.

[Drawing 11] The sequence diagram showing another example of the protocol variation operation at the time of the communication in the system shown in drawing 1.

[Description of Notations]

CS1-CSn -- Base station

PS1-PSm -- Moving terminal device

IN1 -- ISDN network

IN2 -- I' network

PN -- Leased line network

AS -- Server apparatus

GW -- Gateway

1, 10 -- Wireless section

2, 20 -- Modem section

3, 30 -- TDMA section

4 -- Call part

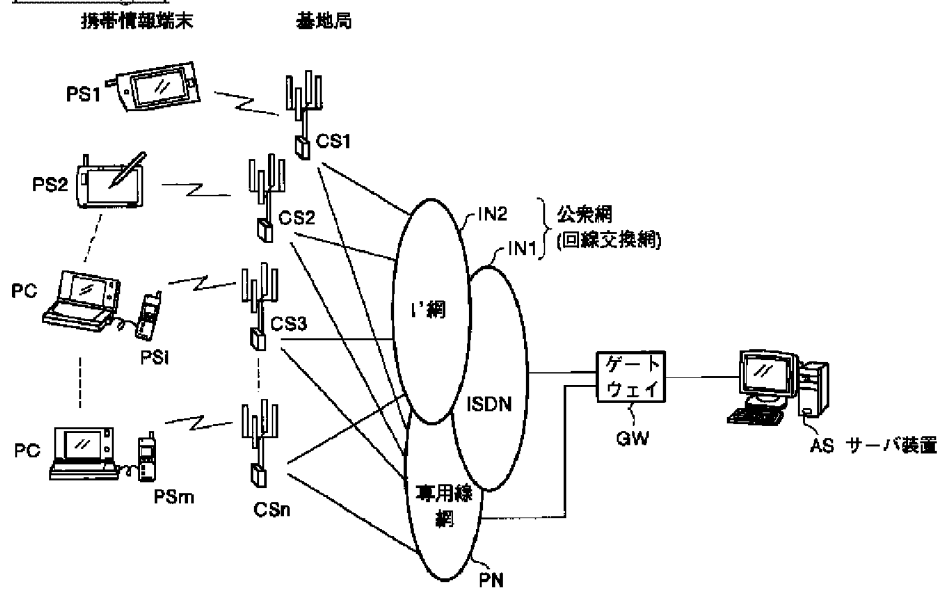
5, 50 -- Control section

6, 60 -- Information storage part  
7, 70 -- Data communication part  
8 -- Indicator  
9 -- Input part  
11,111 -- Antenna  
12,112 -- High frequency switch (SW)  
13,113 -- Receive section  
14,114 -- Frequency synthesizer  
15,115 -- Transmission section  
16,116 -- Receiving-field-intensity primary detecting element (RSSI)  
21,221 -- Demodulation section  
22,222 -- Modulation part  
31,331 -- TDMA decode part  
32,332 -- TDMA encode part  
40 -- Interface part  
41,441 -- ADPCM transcoder  
42 -- PCM codec  
43 -- Loudspeaker  
44 -- Microphone  
51 -- Notice reception means of a protocol  
52 -- Re connection control means  
442 -- Public line interface  
443 -- Dedicated line interface  
551 -- Call connection control means  
552 -- Protocol alteration decision means  
553 -- Protocol selecting means  
554 -- Protocol notification control means

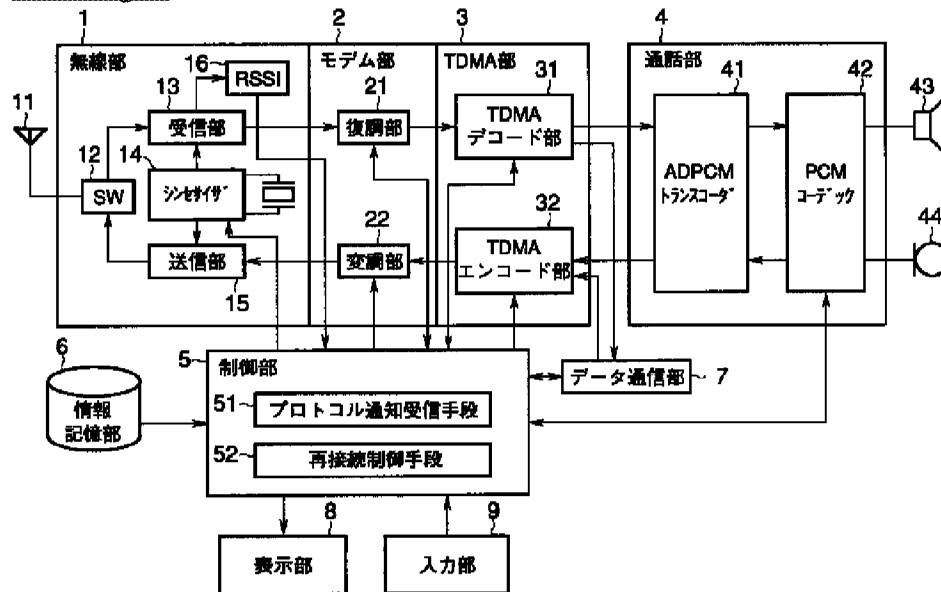
## **DRAWINGS**

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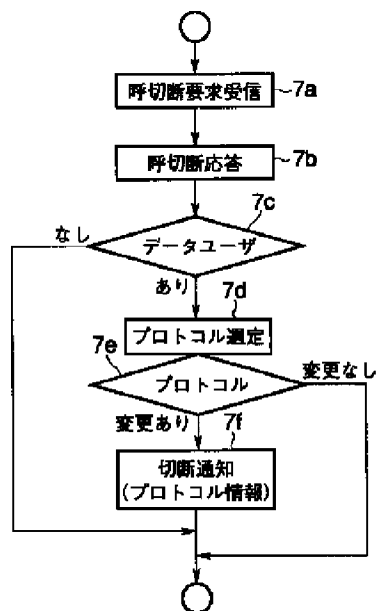
[Drawing 1]



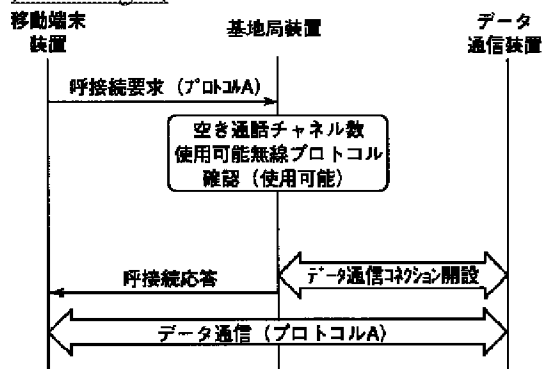
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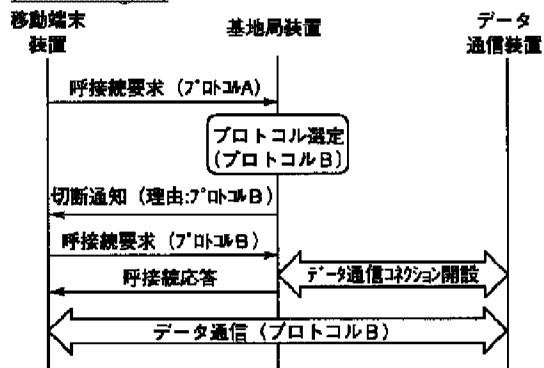
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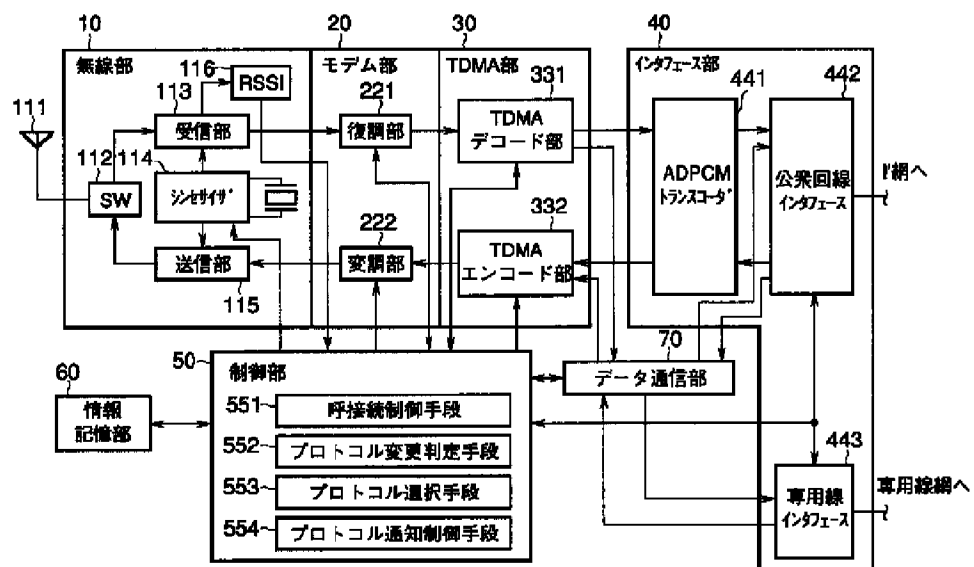
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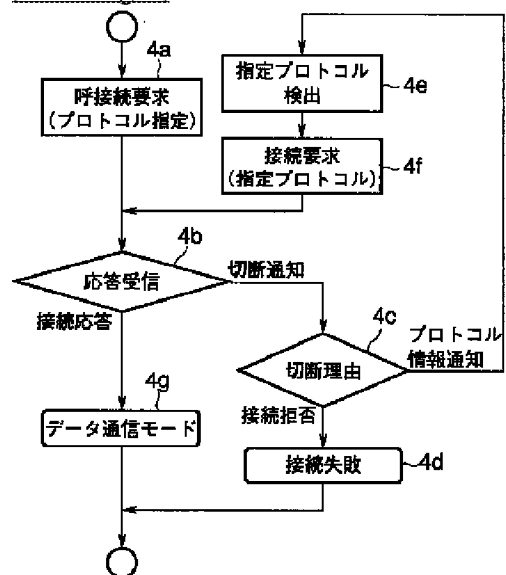
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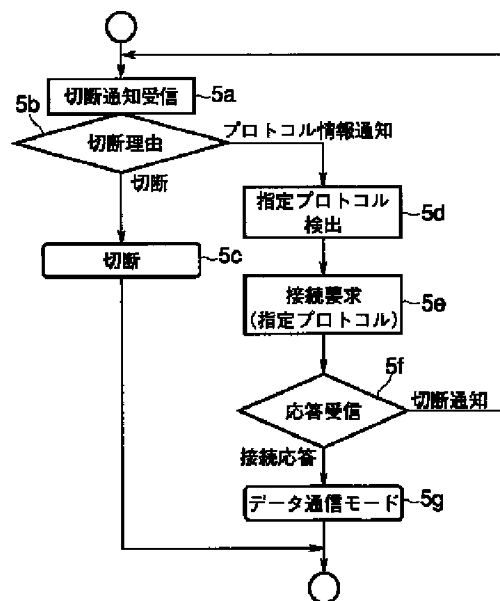
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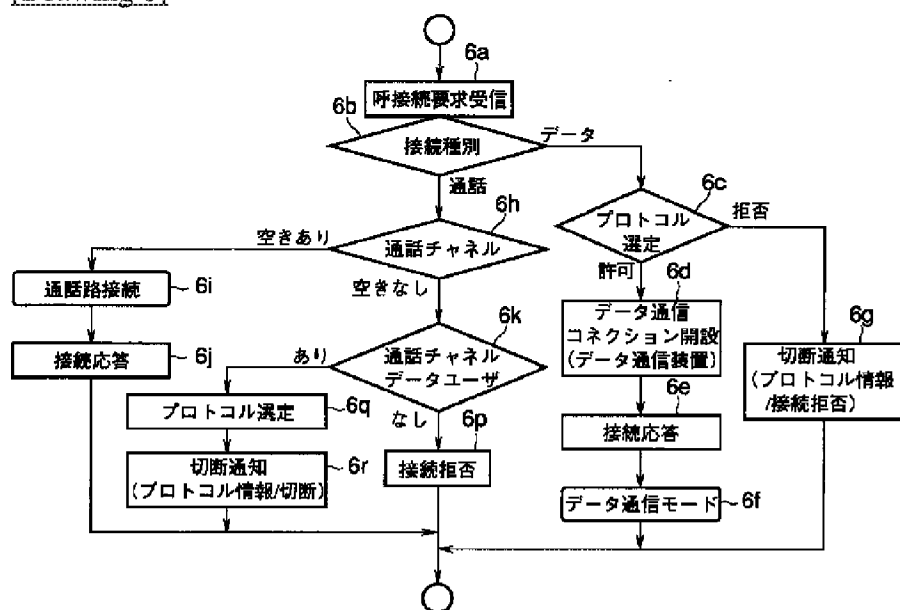
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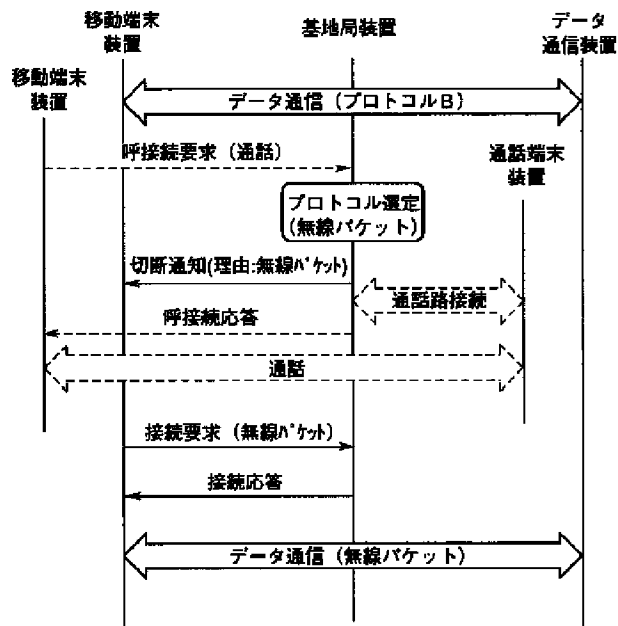
[Drawing 5]



[Drawing 6]



[Drawing 10]



[Drawing 11]

